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THE NORTH AMERICAN DESERTS

BY

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Four years ago I had the honor to report to you on the observations which I made with Professor Schweinfurth in the Egyptian deserts. Since that time I have been again in Egypt, have touched the desert of northern India, and have been much occupied with the literature of deserts; and last autumn I seized the opportunity offered by the fifth International Geologic Congress at Washington to look at the American deserts.

The great geologic excursion through North America, under the professional guidance of our American colleagues, passed for some days through deserts and gave me opportunity for several side trips into neighboring deserts; afterward, in company with Dr von dem Borne, I spent two weeks in traveling through the deserts of Arizona, California and Texas, and met with a hospitable reception in the tent camp of Professor Streeruwitz, of the geological survey of Texas. Through his kind leadership I was enabled in a few days to visit the most interesting points in western Texas, in the Sierra de los Dolores, and in the Sierra del Diablo.

Our first acquaintance with a desert-like region was made in the "Bad Lands" of Dakota. When we awoke on the morning of September 5 our train was on the prairie. A gently undulating plain allowed our eyes to roam to the distant horizon. The gray moraine soil was covered with a dense nap of grass, now sulphur-yellow, now rust-brown. Over it extended, gossamer-like, a silvery gray veil, formed of countless delicate ears of grass. Wherever a depression gave rise to an accumulation of water there appeared a dark-green swamp carpet, overgrown with reeds and rushes, and where the dry prairie grass had been lit by sparks there were seen black bare spots with jagged fire-eaten edges and studded with small, blackened drift bowlders. Inquisitive prairie-dogs sat upright on their hills, a few butterflies were on the wing, one small bird soared in the clear air; on all the wide plain there was nothing else to strike the eye.

In the afternoon there emerged on the horizon sharply outlined table mountains, and at Kurtz station we found ourselves in a landscape full of "Zeugenberge" and mesas. The Americans call the "Zeugenberge" very appropriately "sentinel buttes;" and for the blind-pouchlike wadi valleys penetrating into the table mountains the cowboys use the expression "rim-rock." The rimrock valleys are of great value to the cowboys, because they can drive their great herds into them without danger of losing a single head; for the steep slopes from the gateway to the innermost recesses of these valleys prevent all possibility of escape. Quite similar "sentinel" landscapes were seen by us again in Utah, Colorado and Arizona.

At Ogden, a Mormon town at the northeastern end of Great Salt lake, I left the train in company with Professor Krassnoff of Kharkof. We traversed the tree-lined streets of the pleasant little town and ascended the slope of the Wasatch mountains. Fields of *Helianthus* covered the plain, low oak brush grew along the granite mountains, and scattered opuntias and artemisias proclaimed the dryness of the climate. Finally we reached a gravel terrace 100 paces broad, which could be traced as a horizontal band along all the mountain slopes, 120 meters above the bottom of the valley; this was accompanied by similar parallel lines which might be observed along the rocks to a height of 300 meters.

A superb picture here offered itself to our gaze. At our feet, surrounded by fertile fields and orchards, lay the town of Ogden. An ingenious system of canals irrigated the land and caused a

verdant oasis to rise in the midst of the salt steppe. Next we surveyed the bright blue mirror of the saline lake, from which jagged islands emerged in picturesque beauty; toward the west there followed a white lustrous plain bounded on the far horizon by violet mountain silhouettes.

At present the lake has an average depth of 4 meters; but there was a time when the wide valley basin, 4,500 square kilometers in extent, was covered by a lake 300 meters deep. At that period the breakers cut a terrace in the rocks of the lake shore, and while the lake water evaporated and its level gradually sank, there were formed the various shorelines which now may be traced as horizontal bands in parallel course along all the mountain slopes. Great Salt lake is the last scanty remnant of old "Lake Bonneville," and the salt desert is a dried lake bottom.

In yellow radiance the sun's disk sank behind the mountain crags when on the Southern Pacific railway we traversed part of the salt desert; the night fell quickly, and soon the desert gleamed in the moonshine like glistening hoar-frost.

When we set out next morning from the lonely station of Terrace on a ramble over the desert our expectations were raised to the highest pitch. Krassnoff recalled his travels in Turkestan; I remembered the Arabian desert; and we looked around anxiously, scanning with care each pebble, each sandhill, each sage bush and each rock, in order to compare them with our experiences in Africa and Asia. While Krassnoff quickly felt at home and everywhere discovered resemblances to the steppes of inner Asia, I marveled to see a desert picture unwonted and strange to me. Wherever my eye might stray, it rested on the yellow bloom of *Halophyta*, the silver-grey bushes of *Artemisia*, and spiny cactuses. Among creeping opuntias I saw a few small moss cushions, and at the foot of the granite hills grew juniper trees two meters high with stems a foot in thickness. We walked in short, serpentine windings among bushes a foot in height; some scattered spots were covered with brown pebbles; small sandy water-courses wound, with many a loop, to end on the dazzling white salt plain. As we approached that plain the scrub became scantier, rising island-like from the flat surface, and finally there lay before us the floor-like horizontal plain of saline clay, entirely devoid of plants. The salt formed a coat of fine powder over the gray clay, and the small crystals glistened and sparkled in the sun like fresh-fallen snow. The ground was

honeycombed with polygonal heat cracks, and reflected a glare so intense and dazzling that one could look about only with half-shut eyes.

Krassnoff told me that this landscape agreed in many points with the deserts and takyrs of inner Asia, but I found myself face to face with an entirely new type of desert. I was wont, after several hours' ride over gravel-covered serir or brown hamada, to come to a wadi distinguishable, even from afar, from its plantless surroundings as a green band; I had often been engaged with my bedouin for an hour in gathering dry scrub in order to have the fuel necessary for the fire. Here in the American desert there were plants in abundance, and only the increasing salinity of the soil checked vegetation. Apart from the salt-covered lowlands, I received everywhere the impression of an Egyptian wadi vegetation. Bush stood beside bush, and between them was plantless soil; but on looking over the region from an elevated point, everything seemed sprinkled with blooming green bushes. Now this phyto-geographic habit, or, if I may so term it, the "wadi character" of the whole desert, is not confined to Salt Lake desert, but a similar abundance of plants was found by me in the Mohave desert, the Gila desert, and the deserts of western Texas.

It may often have called forth a smile on the part of my companions to hear me complain again and again of the many plants in the North American deserts; but I cannot sufficiently emphasize the difference as compared with northern Africa. The salt-covered tracts on the shore of Great Salt lake, the bottom of the ancient lake Bonneville, are indeed absolutely plantless, and in this respect delight the heart of the desert traveler; but it must be remembered that in this case it is merely the increasing salinity of the soil that kills vegetation. And when we recall that we here tread on the bottom of a drainless, desiccated diluvial lake, the theory of a Saharan sea, which in the case of northern Africa may well be assumed to have been definitively refuted, might seem to find complete confirmation in Great Salt lake of Utah. There we have a desert whose poverty in vegetation is an effect of evaporated salt water.

I supposed at first that this great wealth of plants in the desert of Utah and Colorado is a consequence of the great topographic altitude, for these deserts have an altitude of more than 1,500 meters. The plateau of the southern Galala in the Arabian

desert in fact is also much richer in plants than the lowlands of the wadi Arabah. But in the low-lying deserts of southern California I soon convinced myself that this conjecture was incorrect. The depression of the Coahuila desert, 260 feet below tide, was unfortunately traversed by me at night, from Indio to Tortuga; but the picture of the landscape which presented itself early next morning at Aztec was almost as rich in vegetation as the Vanhorne desert in western Texas, although Aztec lies at an altitude of 500 feet, Vanhorne at 4,500 feet. It is apparent from this that topographic altitude is not the cause of the wealth of vegetation in American deserts. It seems, on the contrary, either that the average precipitation in American deserts is greater, or that American desert plants are better adapted to dry air. According to Mr Marcus E. Jones of Salt Lake city, that place has an annual rainfall of about 15–16 inches; Salt Lake desert about 6–10 inches.

The conductor of the Southern Pacific railway, who has traveled through Gila desert daily for many years, told me that there is a rainy season in that desert in July and August. The desert sky, at other times so clear, is then clouded; there are occasional thunder-storms in the afternoon; and irregular rain showers fall, their area being so limited that at times the strip receiving rain is only 5 kilometers broad, though the water there covers the ground to a depth of a foot. For the deserts of Texas, according to von Streeruwitz, a mean annual amount of rain cannot be given at all; for in some cases it does not rain for two years, and again there is a rainfall of two inches in two hours.

The plants of the American deserts attain no inconsiderable dimensions. In southern Arizona we rode for three hours through a desert in which columnar cactuses half a meter in diameter and 7 meters in height were to be seen by the thousand. Never have I witnessed so curious a sight as these huge specimens of *Cereus giganteus* in such multitudes. The salsulaceas and artemisias form bushes a meter in height, and their branches are of an arm's thickness; and, while in the Arabian desert one finds but slight protection against the sun's rays under acacias and tamarisks, in Utah the upper slopes bear shade-giving juniper trees.

While there exist thus in the conditions of vegetation wide differences, on the other hand there are a series of important

and characteristic desert phenomena in North America and Africa that present surprising resemblances. In the beginning of October I rode from The Needles through the Mohave desert. On both sides of the railway extended an almost horizontal plain, gently rising toward the granitic and volcanic mountains. So far as the eye could reach, I saw everything covered with scattered desert shrubbery, sprinkling even the slopes of distant mountains in the form of small green points. All mountains, mostly volcanic rocks, dikes and ash-cones, rose island-like from level desert land. The horizontal plain and the steep mountain slopes were not linked together by a débris-covered foothill, but plain and mountain slope intersected without any transition. It is surprising to see steep mountainous islands rise from a sea of débris, and yet this phenomenon is characteristic of all deserts that I have seen in Africa, India and North America. Just as the granite mountains of Sinai or of the Gharib rise island-like from the débris plain in imposing dimensions, and as the plains rise toward the base of the mountains so slowly as hardly to be perceptible until the craggy granite colossus rears its head like our own mountains of massive dolomite, so in the Sierra del Diablo do the plateaus of the Carboniferous limestone rise steeply from a boundless plain, of whose accumulated débris masses one may form an idea on learning that near Torbert at the foot of the Sierra Vanhorne a well was dug 1,050 feet deep in débris. The phenomenon becomes especially striking, because it is noticed that there are no débris deltas at the mouths of valleys 1,000 feet deep; there, too, the horizontal plain is seen to abut directly against the steep slopes of the mountains.

If we conceive each landscape picture as the result of definite processes of denudation, the relation of such a desert plain to its rocky cliffs will at once indicate that denudation in the deserts acts differently from what it does in Europe. But this horizontality of the surfaces of denudation has a further claim on our interest from another point of view.

In the geologic exposures that exhibit to us sections through parts of the earth's crust it is found very frequently that the rock is parted by horizontal planes into layers lying above each other. This structure is called stratification. Now that which in the cross-section of a block of strata appears as a horizontal plane is merely the expression of the fact that at a certain time in the formation of that body of strata the freshly formed sedimentary

surface had the character of a widely extended and approximately horizontal plain. If we now look around on the earth's present surface for regions in which the freshly formed deposits with horizontal planes are being formed, we find them, in the first place, at the bottoms of seas and large inland lakes. In them are formed deposits with horizontal surfaces—that is to say, stratified deposits.

Now, it is very important to note that besides the sea bottom there exists another class of regions of the earth's surface on which the products of denudation are spread with great regularity over wide horizontal areas. These are the deserts and steppes. Both therefore are areas which must not be left out of view in the discussion of the origin of stratified deposits. Stratification does not all originate under water.

The activity of denudation is a double one. It destroys the rocks of the earth's surface and transports the comminuted material from its place of origin. In our regions it is water that destroys the rocks; it dissolves them chemically and frost fissuring comminutes them mechnically. Water is also in our latitudes the most important transporting agency. In the desert it rains but seldom. The time in which water may there destroy rocks and transport débris is at most 65 days in the year. It has been thought that during the remaining 300 days denudation in the desert is at a standstill; yet careful, unbiased study teaches that in these 300 dry days denudation is intense. A burning sun beats down on the rock surface, unprotected by any plant cover. In Texas daily variations in temperature of 40° C. are not at all rare; and large and small stones are cracked by the heat. Often have I picked up the halves of such cracked pebbles still fitting together. In Texas I saw granite blocks as high as houses divided by wide cracks, and Mr von Streeruwitz told me that he had seen and heard the cracking of such blocks. The variously colored constituents of the granite become heated to different degrees and fall apart in the form of coarse gravel. In a valley of the Sierra de los Dolores a rainfall had filled the rocky bottom of the valley with granite gravel to a depth of 3 feet; this gravel had been formed by insolation on the granite rocks in the course of years. Deep caves weather out of the granite wherever the water remains longer, and these increase the mass of the products of denudation.

Thus rocks are destroyed by dry heat at a time when denudation by water sinks to a minimum. On the 300 dry days of the year the process of rock destruction continues uninterruptedly. On rainy days, of course, the loosened rock material is carried off by running water. That such a desert rain-storm, falling like a cloud-burst, may carry off immense masses of débris needs no proof. The question is merely this: Is the transportation of the products of denudation at a standstill in the desert during the 300 dry days? To this question also we must reply in the negative. Almost daily I saw columns of dust traveling slowly over the plain. These raise great quantities of loose material high in the air; there this material is caught by horizontal air currents and carried farther away. I also saw in Colorado how within one-quarter of an hour the desert plain was wrapped in clouds of dust so dense that one could hardly see two kilometers away, while previously the eye might discern everything within a radius of many miles.

Thus we see that even when it does not rain there exists in the desert a transporting force, and that on the 300 dry days neither the destruction of rock nor the transportation of the products of destruction is at rest. We also recognize that this "dry denudation," as it has been called by an English reviewer, is of intense power and may well be compared qualitatively, though not quantitatively, with the denuding effect of water. It will be exceedingly difficult, however, to find a scale by which erosion, that is, denudation by water, can be compared with deflation, that is, denudation by wind; and so long as such a scale is wanting, all conclusions regarding their relative activity must rest on subjective estimates.

Many rocks and rocky surfaces of the African deserts are covered with a peculiar coating, which may be designated as "brown protective coat" or "desert varnish." This coating is also found widely distributed in the deserts of North America, and if I did not succeed in forming a definitive judgment concerning the origin of this product in Egypt, I have now in America made observations which promise to bring the problem nearer to its solution. Mr von Streeruwitz in the beginning of September had made excursions to several parts of the Sierra del Diablo, observing instances of the protective coat, which he intended afterward to show me. Toward the end of September cloud-

bursts descended there, and when in the beginning of October we entered the valleys of the Sierra, we found to our astonishment that the protective coat had everywhere been torn away, and only a few shreds of it hung against some of the walls. Even where there had merely been a pool of water in a depression, and where therefore the chemical rather than the mechanical force of the water had been active, we found the desert varnish removed. From this appears with certainty what previously I could express only as conjecture:

(1) That the brown protective coat is not formed by the aid of water, and—

(2) That it is torn off and removed wherever rainwater has access.

Now, the latter fact also throws some light on a phenomenon which was previously a perfect enigma. In the African deserts, sandstones or limestones, more rarely granite, are found weathered in such manner that the face of a rock wall is broken by niches or crannies 10 to 100 centimeters high, 5 to 50 centimeters broad, separated by columns reaching a meter in height. Behind these columns—that is to say, in the interior of the rock wall—runs a passageway, at times large enough to allow a man to crawl along it. Both Professor Schweinfurth and myself were convinced that in the formation of these columned passages rainwater had played a part; our views diverged only on the question whether the columns had at one time been washed by descending rain rills or whether that had been the case with the holes between them. By the recent observations it is placed beyond doubt that only the holes can have been formed by water.

Professor Sickenberger of Cairo has been engaged for a year on investigations on the chemical processes involved in the formation of desert varnish, and important results are to be expected from him, confirming the views here set forth.

I attach great importance to a letter I received from Professor von Streeruwitz, who, in his laboratory at Austin, "Kept a protective coat, absolutely free from manganese, in an ozonized atmosphere for two weeks. It rapidly grew darker, and in the course of a few months assumed the color which those rocks had before the cloud-burst." This fact shows how correct is G. Rohlfs in calling attention, as he did again recently, to the significance of electricity in deserts, and how important would be the institution of exact determinations of electricity in some desert.

From what has thus far been stated, it is evident that the North American deserts agree with the Egyptian deserts in all essential and characteristic points. There are striking differences in plant geography, it is true, in that the American deserts on the whole are much richer in vegetation, probably by reason of greater precipitation. It is probably for this reason that erosion plays a larger and more important part than in Egypt. But the topographic character is the same: the prevalence of horizontal plains with island-like mountains rising from them; the frequency of isolated "Zeugenberge," or island mountains and of amphitheaters in the valleys; the intense energy of insolation, cracking bowlders and pebbles and causing varicolored granite to crumble into loose gravel; the appearance of mushroom rocks and columned galleries; and the wide distribution of the desert varnish, a phenomenon which must be regarded as a specific effect of dry climate and scarcity of rain. The denuding effect of wind is apparent not only in the characters of the surface forms just named, which are essentially different from the forms of erosion, but it may also be observed directly when dust storms career over the desert. As in northern Africa, so in North America there are found four types of denudation products or sediments: gravel deposits, sand dunes, clay tracts and salt deposits.

In view of such agreement in the primary and secondary geologic phenomena of the deserts, geographically so far apart, of northern Africa and North America, despite the different conditions of vegetation, one is justified in regarding the phenomenon of desert formation as one of the great telluric processes, a process having its own laws just as much as the glacial phenomena of the polar zone or the cumulative weathering of the tropics. Transferring this principle to the domain of earth history, there arises the problem of searching for the remains of fossil deserts in the strata of the earth's crust with the same care with which in recent time fossil glacial periods are reconstructed.

But the study of deserts has another important consequence. The desert is an extreme of climatologic conditions. Dry air and dry heat, which in our temperate climate make their appearance on a few days only in the year, are active in the desert for the larger part of the year. Their effect in the desert is prominent; in our regions it occupies a very modest place; but

it would be unfair to deny their denuding agency even in our regions. There are so many phenomena near us which can hardly be explained as effects of water and ice, but which become easily intelligible as soon as we recognize dry air in motion as a geologic force. There is perhaps not a spot on earth that bears no trace of erosion; neither, on the other hand, is there a spot where the activity of wind denudation or deflation is entirely absent. It is only a question of unbiased observation of nature, and of not attributing to water things which it cannot accomplish.

How close together and in how intimate union erosion and deflation act is shown by an eloquent example, the famous Colorado canyon in Arizona. Most of the members of the great excursion expected that our way from the railway at Flagstaff to the Colorado canyon would lead through a desert. What was our surprise, therefore, when we found that it led for 120 kilometers over a plateau more than 2,000 meters high, with prairies and beautiful pine woods. The shady growth of *Pinus ponderosa* extended to the very edge of the canyon gorge, and as we climbed the last steep slope we were able to come within two steps of the canyon without imagining how close we were to the coveted goal. One step, and we stood on the verge of a gorge 2,000 meters deep, and only at a distance of 20 kilometers did we see the steep verge of the other shore. A magic twilight as yet reigned in the purple depth; only the topmost crags of some rocky towers burned with the rosy glow of the rising sun. Our eyes swept along the horizon, and as far as they could reach there appeared an uninterrupted mantle of forest; only toward the southeast the snow-covered peak of mount San Francisco emerged like another Etna, while toward the north, more than 200 kilometers away in an air-line, arose the gourd-like mount Navajo. Again we looked down into the fathomless depth, gradually illumined by reflection from the upper peaks glittering in the sunlight. The rock walls seemed to glow as with transparent light, and only with difficulty could the eye distinguish details. Little by little the purple glow and the deep blue shadows of the abyss disappeared, and as the sun rose higher and higher, the shadows grew shorter. Like jutting battlements and fairy-like palaces, one rock structure after another disclosed itself. At last we were able to scan the steep walls, to recognize with complete distinctness the Cambrian unconformity, and even at one point to see the river rushing along.

The relation of the bed of the Colorado to the canyon can be better recognized, however, if, proceeding along the upper edge eastward, one finally reaches the point seen and described for the first time by the Spanish commander Coronado in 1542. Spanish point lies at the extremity of one of those wooded tongues of land which project so far toward the middle of the gorge that one is able to survey the river for a considerable distance along its middle line. It has already been pointed out by Dutton, and the view from Spanish point easily shows it, that the canyon is divided into two parts. At the bottom the river is seen rushing along in a narrow gorge cut in gneiss, and our ears catch the muffled roar of the mighty stream that rolls its brown-red flood over rapids and reefs. The bed at times is so narrow that the rocks rise perpendicularly 400 meters from the water, and only on turning northward, where the Little Colorado breaks forth from its narrow gateway of rock, do we see the river bed widening and even bordered by a green fringe of low bushes.

That this trench traversed by the Colorado and mostly of gorge-like narrowness is an effect of erosion, that it was cut by the river and is still being deepened, is not open to the least doubt; but when we turn our eyes to the edge of this interior groove of erosion we see at once a different landscape. The strata referred to the Silurian and Devonian represent a shelf several kilometers in breadth, designated by Dutton as the "esplanade." The edges of the strata appear distinctly as delicate isohypsal lines, and the valley widens with very gentle slope, to be succeeded again by escarpments 1,000 meters high. But the widening above the esplanade is not uniform; for the promontory of Spanish point forms a sheer wall only a few kilometers distant from the river, while alongside it deep, semi circular kettles enter 5 to 8 kilometers into the plateau, and thereby carry back the edge of the canyon gorge as far as 10 kilometers from the erosion groove of the river.

Were we to cast a birdseye view on the whole valley system we should see in the middle a uniform, steeply carved groove, which at a certain point of its depth all at once widens greatly and appears fringed with deep, semicircular bays. If from Spanish point we look westward, we gaze into such an amphitheater. With sheer walls 800 meters high, it rises from the esplanade; nowhere could the bold foot of a mountain-climber

find a hold; with dull rumbling the blocks loosened by our feet from the edge of the abyss tumble down into the vast depth. The upper edge is cut sharp as with a knife; nowhere do we see a rivulet descending; nay, the plane of the plateau slopes so steeply away from the edge that even in heavy rainfall no torrent could tumble over it—the whole region is drained toward the land, away from the gorge.

Like an enigma these amphitheaters now appear to us; all the more so when we learn from Major Powell, the famous explorer of the canyon, how rarely it rains here. Major Powell had not thought it necessary to take along tents for us, and when in one bad, stormy night we lay shivering around the smoky fire, unprotected against the hail and the streaming rain, not a few of us must have received the impression that we were in a region of large precipitation; and yet that storm was an unforeseen exception. But even if rain were more frequent than it is, still on account of the topographic conditions of drainage the amphitheaters would be affected only by the erosion of that water which falls on their surface. Bursts of rain from thunder-storms generated within the canyon, such as were graphically described to us by Major Powell, may indeed wash down all the débris which has become loosened in the course of the rainless period, but nevertheless the denuding effect of water can there be only secondary.

But where is the force that carved such amphitheaters? Where is the cause of so singular forms of denudation? Again we stand face to face with the question whether in these kettles denudation is at rest during the 300 rainless days. If we observe with unbiased minds what are the forces that act during these 300 rainless days, we see dry air and dry heat exerting their destructive influence on the rocks. The eye trained for such processes recognizes that the heat of the day, alternating with the cold of the night, may produce the same effect as fissure-frost in our latitudes. We ourselves experienced variations of temperature of 30° C. within the canyon. Thus insolation and weathering penetrate into the rocks and break them, and the wind carries off the light powder of the weathering. The harder ledges of rock are undermined without the aid of eroding water, hang over, and await the first rain-storm. Now comes one of those rare cloud-bursts. The water everywhere finds loose débris and shaky blocks. Thus the relatively small amount of water

is able to detach and sweep down a much larger amount of débris which afterward the Colorado carries out into the gulf of California.

Thus we see in the canyon of the Colorado an interesting example of the combined action of erosion and deflation. We recognize in the inner gorge a simple channel of erosion; we observe that the upper amphitheaters owe their existence to the coöperation of erosion and deflation.

Now, what we here see in the Colorado, that we see everywhere on earth where the soil is not covered by a mantle of water, snow or vegetation. There is no need of traveling into the deserts in order to recognize the denuding activity of wind; and in the driest desert the traces of erosion may be observed. There is no region absolutely devoid of precipitation, and, on the other hand, deflation may be observed in the rainiest climate. When on a dry autumn day you walk along the highway and are annoyed by whirling clouds of dust, you are witnessing the denuding effect of wind. Every sand dune is the result of the same force. Every clay bed ("Lehmlager") teaches how vast deposits are produced by wind, and the loess beds of China are supposed to be merely a product of deflation. We say of the wind that it "sweeps" over the ground; for this word means nothing else than that the wind cleans the ground of all loose particles that cover it. Translated into technical geologic language, it is called "deflation," but that means nothing else than the every-day word "sweep."

One must learn to recognize the sweeping activity of the wind not only in the desert but everywhere, and in so doing to detect in its very beginning the process whose final product von Richthofen sees in the loess.

THE ALASKAN BOUNDARY SURVEY

I—INTRODUCTION

BY

DR T. C. MENDENHALL

(*Presented before the Society March 4, 1892*)

As an introduction to what Mr McGrath and Mr Turner will have to say to you to-night, I have been requested to say something with regard to the origin of the expedition from which they have so recently returned. Everybody present is doubtless familiar with the fact that in 1867 the United States government purchased from Russia that which was then known as Russian America and is now known as Alaska, paying for the same the sum of $7,200,000. There can be no doubt that this was a wise and profitable investment at the time, as it can readily be shown that the territory has returned to the United States in cash more than it cost, and we are just beginning to measure and to understand the real resources which will some time in the future be available. It was perhaps not generally expected at the time, if indeed it was expected at all, that in the purchase of the territory we were also coming into possession of two or three interesting and somewhat provoking controversies. One of these is with regard to the boundary line which separates Alaska from the possessions of Great Britain in North America. This boundary line was originally defined in a treaty between Great Britain and Russia in the year 1825; and in purchasing Alaska from Russia we acquired an interest in the boundary line as defined in that treaty.

Although it was doubtless thought at first that the boundary line was well and satisfactorily defined, it has since come to be generally recognized that the definition is very unsatisfactory, by reason of the fact that it was based upon the very meager information available at the time the treaty was made. I may remind you briefly that the treaty defines the line as beginning

at the southernmost extremity of Prince of Wales island, which point was supposed to lie on the parallel 54° 40′ north latitude; thence, "It shall ascend along the Portland canal until the 50th parallel of north latitude is reached." From this point, in accordance with the treaty, it shall follow the line marked by the summits of the range of mountains parallel to the coast until such line meets with the 141st degree of longitude west of Greenwich. From this point it shall proceed along the 141st meridian west of Greenwich until the Arctic ocean, or the "frozen ocean," which is the term used in the treaty, is reached. In a supplementary paragraph it was agreed that all of the island known as the island of the Prince of Wales should belong to Russia, and hence, in virtue of our purchase, to the United States; and also that whenever the summit of the range of mountains referred to before shall be at a greater distance from the coast than ten marine leagues, the limit of the possessions of Russia shall be formed by a line parallel to the windings of the coast and never more than ten marine leagues from the shore.

It will thus be seen that the boundary line is divided into two parts which differ materially from each other. One of these is that line which proceeds from a point near mount Saint Elias—that is to say, the 141st meridian of longitude west from Greenwich—and runs directly north to the frozen ocean. This, being an astronomical line, can readily be located by astronomical methods and should give rise to no controversy. That part of the line, however, which separates what is known as southeastern Alaska from the British possessions is by no means simple and easily determined. At the time the treaty was made between Russia and Great Britain the best information available was that contained in Vancouver's map, which was, and in some respects is still, the best available representation of Bering sea and that part of North America. It seems tolerably certain, however, at the present time that the range of mountains which was assumed to run parallel to the coast has no real existence, and that it is therefore necessary to fall back upon the second definition of the boundary line—that is, the line which is to run parallel to the windings of the shore and be nowhere more than ten marine leagues from the same.

Experience has shown that the longer a question concerning the location of the boundary between two great nations is left unsettled the more difficult it becomes to decide it in a manner satisfactory

to both. In a region which is sparsely settled and where there are and can be few interests, either public or private, that conflict in any way, it is not difficult to determine a boundary line without dispute. The postponement of the question, however, may leave it undetermined until the population is greatly increased, property becomes more valuable, and mineral or other resources have been discovered which make it important to each contending side that every foot of territory shall be contested for.

A very few years after the Alaska purchase (in 1872) General Grant, then President of the United States, recognizing the difficulties attending the settlement of this question, and especially the difficulties which might arise from its further postponement, recommended in his annual message to Congress the appointment of a commission for settling the boundary line between Alaska and the possessions of Great Britain. The country being practically unsurveyed, it became necessary to consider a method for a suitable survey of the country adjacent to the boundary line in order that it might be correctly defined, and various estimates of the cost of such an operation and the length of time required for its execution were made at that time. The matter was then allowed to drop, however, and nothing further was done until nearly fifteen years later, when President Cleveland again brought the subject forward by referring to it in his message to Congress.

In the estimates submitted for the year 1888 an item of $100,000 was inserted by the Department of State for a preliminary survey of this boundary. No action was taken upon this item, however, but in the following year an appropriation of $20,000 was made, the survey to be conducted by the United States Coast and Geodetic Survey in accordance with plans or projects approved by the Secretary of State. In drawing up the plan for the work it was agreed to begin the operations by the establishment of points upon the 141st meridian west of Greenwich. In order to accomplish this it was necessary to send observers into the interior, and for this purpose in the spring of 1889 two parties were organized to ascend the Yukon river and its branch, the Porcupine, in order to establish camps as near as possible to the 141st meridian for the purpose of making the necessary astronomical observations for the determination of its location. They were also instructed to execute such triangula-

tion and topography as would be necessary for the identification of the locations of the observing camps, and to establish permanent monuments as nearly as may be upon the meridian line.

These two parties, one to occupy a camp on the Yukon river as nearly as possible where it is intersected by the 141st meridian and the other on the Porcupine, were directed respectively by Mr McGrath and Mr Turner, whose observations are summarized in the following papers.

It was estimated that one year would be sufficient for the accomplishment of the work, and this estimate was a liberal one, provided ordinary weather conditions had prevailed in that part of the country. It was found, however, that these conditions were extremely unfavorable, especially for astronomical work, on account of the continued cloudiness, rendering observations for a long time absolutely impossible. The extreme low temperature also rendered work difficult, and this of itself would have stood in the way of an early completion of the task had it been possible to carry on the astronomical observations. It thus happened that, notwithstanding the rigor of the climate and the difficulty, if not impossibility, of obtaining supplies from outside sources, these parties were obliged to remain in the interior of Alaska during two years. Notwithstanding the unfavorable conditions under which they existed during this time, every individual of both parties returned in good health and in good condition. Indeed, there was scarcely a case of even ordinary illness during the entire campaign, a fact which must reflect great credit upon those charged with the management of the parties.

So far as we have been able to ascertain by recollections and comparisons made up to this date, the work with which Messrs McGrath and Turner were charged has been done in a manner entirely satisfactory and so as to reflect great credit upon these gentlemen. I am sure they have very much to tell you which is of interest in relation to their experiences in this almost unknown and unexplored region, and I will not longer stand in the way of their doing so.

II—THE BOUNDARY SOUTH OF FORT YUKON

BY

J. E. McGRATH

The address of Dr Mendenhall having satisfactorily described the duties which called our party into the interior of Alaska, I shall confine myself to a plain statement of the most prominent points of interest connected with the people and country that came under my observation during a two years' stay in our great northwestern possession. It may not be amiss to call attention to a few salient facts about this vast territory, whose remoteness from the rest of the country has caused but little attention to be paid to its possibilities and character by the people at large until the rights of certain of its old-time inhabitants to peaceful occupation of some favorite summer resorts of theirs on a few small islands off its coast had been rudely interfered with.

Alaska has an area of nearly 580,000 square miles. Its shore line exceeds in length the combined lengths of the Atlantic, Pacific and Gulf coasts belonging to the United States by 7,239 miles. The ocean that freezes along its northern coast is the resort of the greatest whaling fleet in the world. Its islands of Saint Paul and Saint George are the breeding places of the fur seal, for hunting which a company pay the United States government a royalty which equals (when the maximum catch is allowed) about ten per cent on the cost of the whole of Alaska; in the archipelago which extends about the national domain and nearly 8° of longitude into the eastern hemisphere are the haunts of one of the most highly prized of all fur-bearing animals, the sea otter; on the banks off the Alaskan peninsula the Fish Commission steamer *Albatross* has found those very valuable food fishes, the cod and halibut, in such numbers as to make these seas compare favorably with the rich fishing banks of Newfoundland; along the southeastern coast a large mining population is profitably employed, and at the great Treadwell mine on Douglas island (near Juneau) the largest stamp mill in the world is engaged in crushing Alaskan ores; along every favorable bay and stream on the southern coast salmon canneries are to be found, and the importance of this industry may be appreciated when it is considered that the season's pack for 1889 amounted

to 703,000 cases. In the interior gold, copper and coal have been found, but as yet the most valuable exports are the many rich furs for which Alaska has long been noted.

No feature of Alaska is more remarkable and noteworthy, geographically, than its great river, the Yukon. This mighty stream, rising within twenty miles of the Pacific ocean (estimated from the head of Lynn canal), flows for about 1,000 miles northwesterly, passing inside the arctic circle, near fort Yukon, and then, bending its course south-southwestward, flows on for another 1,000 miles until it reaches Bering sea.

The Russians during their domination in Alaska did but little in the way of exploring the interior, and it remained for the hardy pioneers of the Western Union Telegraph expedition, who were occupied during 1866 and 1867 in selecting a route for a telegraph line to connect Europe and America by way of Siberia, established the identity of the river known to the British as the Lewes and to the Russians as the Kwikpak or Yukon.

In the early days the trade of the river was divided between the two peoples just mentioned. The Hudson Bay company had established a post at fort Yukon, and the servants of this company received their goods by dog trains from the Mackenzie River district, extending their operations as far down the river as Nuklukayet, near the mouth of Tanana river, and so securing the trade which at the present day is considered the best in the Yukon district. The Russians had to bring their supplies up the Yukon in sailing vessels, and with this slow means of transportation found Nulato far enough in the interior for their trading post. The English occupation of the site of fort Yukon continued until 1869. In that year Captain Raymond, of the United States Engineers, was sent up the river to determine the location of the post. A total eclipse of the sun afforded him an admirable opportunity to determine his longitude. This being supplemented by observations of the moon and moon-culminating stars, a latitude was observed; and then, as it was placed beyond doubt that the station was in the United States territory, the Hudson Bay company retired up Porcupine river to a point that the factor, Mr McDougall, thought was well within the British possessions. Captain Raymond also mapped the river between fort Yukon and its mouth, and when Lieutenant Schwatka made his famous raft journey down the river (from its head) in 1883 he supplemented Raymond's work, and for the first time a fair idea of the course of Yukon river was given to the world.

Captain Everett Smith, of the Western Union Telegraph expedition, made a reconnaissance of the delta, and the present maps nearly all use the chart made by him of the mouth of the river. The great reward for the pioneers in the salmon canning trade on this river has made the agents of the Alaska Commercial company at Saint Michael very anxious to discover a channel in the river up which ocean-going vessels might be taken. At present all stores intended for the Yukon river valley must be taken to Saint Michael and there transferred to small, light-draught river steamboats, which then have a risky outside sea voyage of eighty miles before they can find safety in the most northerly of the outlets of the river, which is the Aphoon mouth. Its great volume of water is poured out through so many different channels that in no one can a sufficient depth be found to allow of admittance into the river of sea-going vessels. Tempted by the prize which is in store for the first ones to establish salmon canneries on the river, the Alaska company's agents have spent much time in searching for a deep-water channel. In this quest they can secure no help from the natives, who appreciate what the consequences will be for themselves if the white man can bring his ships in, and hitherto the search has been a failure.

The inhabitants of the lower Yukon were the most miserable, foul and degraded beings that we saw in Alaska. Of personal cleanliness they seem to have no conception, and it was distressing to note the terrible diseases under which some of them seemed to be wasting away. The chief reason for their dreadful personal condition is their partiality for seal oil under all conditions and circumstances. They seemed to steep themselves in it. It never has an odor which would make it acceptable to civilized people, and coat after coat of this stuff, laid on from childhood to old age, results in making the person so treated a very unwelcome object for notice for either nose or eye of the white man. The lower part of the delta is regularly submerged each spring, and often the miserable dwellers therein have to seek refuge in their boats; but just so soon as the waters subside the people return to their damp and sodden hovels, which really never dry out entirely, on account of the excessive rain that characterizes the lower river. This condition of person and dwelling, together with an almost exclusive fish diet for one-half the year, results in some terrible forms of diseases among the Maklemuts, and at various points we saw poor miserable creatures whose condition

was more hideous than anything I ever read of the worst effects of plague or leprosy.

In spring, summer and fall this section is the home for innumerable geese, swans and ducks. The Maklemut then lives well, and we were told wonderful stories of the number of birds killed by single hunters in a day's hunting. Two wild geese could be bought in some places for a head of tobacco, and a miner told us that the ruling rate for wild-goose eggs at the trader's store near cape Romannoff was a head of tobacco, or one-third of a pound of lead for 150 eggs. It is needless to say that the native inhabitants of this section are not very particular about the quality or condition of the food they eat There are no fastidious scruples about the cause of the death of their game. A white whale or seal that drifts ashore is taken with thanks, and if it is evident that the creature has been dead for some time there is the compensating advantage that the flesh is more tender.

The Yukon river does not lack for settlements, but their size and condition hardly satisfied the ideas we had formed of them before they greeted our view. Kotlik is the home for a single white man, the old Russian trader and his family. Andreafski is only a name; a portion of the old storehouse here came in very handy for wood supplies when we passed it going up river. Ikogumut has some importance because it is the home of the Russian priest who has spiritual charge of most of the natives of the lower river. Kozerehhski is a few miles above the large Catholic mission of the Holy Cross. White Anvik affords a home to the bishop elect of the Episcopal diocese of interior Alaska. Next above Anvik is Nulato, once the outpost of the Russian Trading company and noted for being the scene (so graphically described by Professor Dall in his work on Alaska) of the only massacre perpetrated by the Indians on white people in the Yukon valley. The next station of note after passing Nulato is Nuklukayet, the emporium for the trade of Tanana river and the most productive trading post on the Yukon. About 100 miles above Nuklukayet the Yukon begins to spread out into the great lake-like section which is locally known as the "flats." In this portion of its course the stream is dotted with myriads of islands The great width of the river and the constant changes in the shallow channels leading to every point of the compass make this the most dreaded part of the river for the steamboat-men. Near fort Yukon the river is said to be seven miles wide.

Probably no point on the Yukon is better known by name to people who have not visited the interior of Alaska than fort Yukon. Here once was the largest and best-equipped trading station on the river. It was the most westerly of the Hudson Bay company's posts, and until Captain Raymond determined that the site was within the territory of the United States, it controlled all the trade of the upper river. Now a broken chimney, several mounds of ashes, and a few graves are all the evidences that remain to show where the great station once was.

Above fort Yukon the names of a number of places appear on our maps, but in reality only two locations are permanently occupied on the whole upper half of the river. These are at the mouth of Forty Mile creek and at the site of old fort Selkirk. The scenery along Yukon river will compare favorably with any views I have ever beheld myself or seen reproductions of from any river in our country. Our summer trip up the stream was one continued succession of pleasant surprises. The hills were heavily wooded with spruce, birch and aspen; on shore we found flowers on every side, while birds and insects were as plentiful as we ever saw them in the northern states. At fort Yukon, which is little over a mile inside the arctic circle, the heat was almost insufferable, both in August and July; and the only warning given us of what we might expect a little later on was afforded at Nulato, where we saw a well being sunk which had already been driven through twenty-five feet of frozen ground. In spite of our pleasant summer, as we were all ignorant of what might be the rigors of an arctic winter, there was much anxiety about what the future would have in store for us. All the traders at Saint Michael were certain that the coming winter would be a severe one, because the one just passed had been very mild. Rain had fallen on Forty Mile creek on January 1, 1889, and, according to all the laws of Alaskan weather, the approaching winter would have to make up for the mildness of the preceding one. Mr McGuesten told us of the winter of 1886, when the signal service thermometer at his station recorded —70°, and his face was frozen while going about fifty feet from his house to call some miners who lived in a cabin near by to see how low the temperature was. Mr Mayo was certain that a later winter was still colder, but unfortunately he had no spirit thermometer that year, and so he had to judge entirely by his sensations. With all this expert testimony we began to anticipate trouble.

A careful estimate was made of what wood we would need for our three fires, and it was with much foreboding of its inadequacy that we saw the winter start in while we had only enough wood on hand to last, as it afterwards turned out, for two years, and then have enough left over to give the steamboat *Arctic* four or five cords when we abandoned the camp in 1891.

During the first winter the temperature fell to — 59°, while the second season gave us a still lower minimum, or — 60.5°. We had a long spell in January and February, 1890, when the temperature did not get above 82° below the freezing-point (— 50°), but at no time did this cause any suffering. Our systems became gradually inured to the cold and, without any such amount of extra clothing as would excite comment in the middle states in winter, we were able to go about attending to our regular duties, and taking the indoor exercise that was necessary for our keeping in good health. Fur garments were worn only when the members of the party went on journeys, and then they were taken for use at night, as we used no tents in any of our trips. In the quarters fires were not kept up beyond our time for retiring, except when observations kept us up all night; but, in spite of this, water never froze in the room the men occupied, and in the roof of the officers' room an opening eighteen inches square was kept open summer and winter for ventilating purposes. I suppose our capacity for assimilating fats was very much increased from a little discovery I made last March. One day, while looking over the report of the provisions used by the party, I noticed an extraordinarily large amount of lard charged. As it showed that the man who was acting as cook was using monthly twice as much of this article as his predecessor in office (who was allowed to return home in the previous August) had used in six months, I called on him for an explanation. He claimed that he was using it in a regular and proper way, and when asked for what purposes it went, he said that, for one thing, he always put a pound of it in the soup every day. No one had developed any attack of dyspepsia during the season, and I suppose we must thank our climatic surroundings for being saved from the natural consequences of this practice.

During the intense cold the mercury froze, of course. On Forty Mile creek one experimenter made bullets of this metal, which he fitted into cartridges and fired from his rifle. We amused ourselves with making mercury discs which we would

break to see the fracture. Coal-oil and California brandy were also experimented with and solidified in a very short time.

The principal sources of worry and suffering at an arctic station are to be found in the short, dark days of winter and the long, bright days of summer. Our first winter was made rather worse than usual because of the small amount of oil we had to carry us through. For twenty hours each day during the months of December and January no reading or writing could be done in quarters without the aid of artificial light, and as we only had enough oil on hand to allow us to keep a lamp going for four hours per day, we had many a dark hour to endure, and those two months appeared almost endless. The long day of the summer seems to affect some people even more than the long night of winter; they appear to become nervous, and on the whaling fleet it is not unusual for men to become insane, and some are driven to suicide. At camp Davidson we were not inside the arctic circle, but nevertheless no stars were visible to the naked eye from about April 25 to August 15, and in June at midnight diamond print could be read by natural light out of doors. Some members of the party suffered severly from insomnia during the summer, and it did not seem to help them in any way when the heaviest cloths were used to curtain their cots.

Although 1,400 miles in the interior and certain of a mail only once a year, we could not complain of loneliness while the Indians were near us, and very few indeed were the days that some of those social people omitted calling and breakfasting, dining or supping with us. Taken as a whole, the Indians in our vicinity were clean, honest, gentle and virtuous. Never have they occasioned the white men who came among them any trouble, and hitherto the mutual relations of the two races have been of the most cordial and pleasant character.

The miners early recognized the necessity of seeing that none of their number should do the Indians injustice, and rigid laws have been adopted to enforce due consideration of Indian rights. Whatever work an Indian does for a miner or whatever he sells one is paid for, generally at a high price. Indians working in mining claims receive three to four dollars per day, which is relatively higher than the eight dollars paid to white men.

What the outcome of the Alaskan placer mines will be is beyond any one's power to estimate now. The miners have prospected on nearly every stream in the country; even the Arctic

portions of the territory have not proven inaccessible to those solitary searchers for the precious metal, and everywhere they have found "color," but up to the present time no place has paid steadily and well, except the small river called by the natives Chitandipeh, and by the whites Forty Mile creek. Here last season there were about 150 white men, and when we left camp Davidson in June, 1891, it was the only river below Pelly, except the Kuyukuk, on which mines were worked. The lower part of the Forty Mile is abandoned now, but the richest ground is in the gulches near the head of the creek, and it is estimated that it will be several years before their treasures are all extracted. Mayo and McGuesten are the traders who supply these men with stores, and they told me that their shipments of gold dust for the past year amounted to $40,000, and this, they estimated, was a little less than one-half of the total output of the creek. The regular mining season lasts for only about three months, but some men do a little winter mining, which is extremely laborious. It necessitates first chopping a great quantity of cord-wood, which then has to be hauled to the bar that is being worked. Here it is heaped up in piles and fired, and then the thawed ground is dug out and piled on some bank above high water, and when summer comes and the ice goes it is taken down and washed out. In the winter of 1889–1890 three men took out 23,000 buckets of dirt, which netted them $1,000 apiece for their three months of the hardest kind of mining work known. The largest nuggets ever found in Alaska have been found on Forty Mile creek; one was shown us which was worth $56, and in last July a man named Nelson took out a nugget worth $260. The evidences that Alaska gives on all sides of the existence of gold will always tempt men to go there, but real exhaustive examinations of her streams will not be made until the miners feel sure that when they return to the trading posts after a long season's prospecting they can depend upon finding food there. As affairs are managed now, they must return to the stations in the middle of their short working season to see what the steamboat has brought, and no one can tell when some accident will happen to the one steamer that connects the interior with Saint Michael, and force all hands to leave the country or else face the possibility of starvation, as was the case in the fall of 1889. It is a very risky venture trying to live on the country in the interior of Alaska.

III—THE BOUNDARY NORTH OF FORT YUKON

BY

J. HENRY TURNER

There is perhaps no portion of the vast territory of Alaska so little known as the country stretching northward from fort Yukon to the Arctic ocean, eastward to the international boundary, and westward to the headwaters of Koyukuk river. Simpson and Franklin skirted its northern shore, Allen penetrated into it a short distance, and Stoney proved the existence of a mountain range trending to the eastward. Notwithstanding the fact that the summits of lofty mountains are visible in the horizon to the north of fort Yukon, the impression has long prevailed that the river plains extend to the shores of the frozen ocean. This idea has even been advanced by an explorer of note within the last few years. Travelers have sedulously avoided this region for the obvious reason that the supposed absence of navigable rivers and remoteness of trading posts and other means of communication with the outer world would render it peculiarly unsuited for summer exploration.

It is believed that certain discoveries made during a journey northward from camp Colonna in the spring of 1890 will throw considerable light on the geography of this *terra incognita*. I shall take occasion to revert to this question in closing my remarks.

Mr McGrath has already described the river from its mouth to old fort Yukon, at which point the two parties separated. On August 3 the steamer *Yukon*, with the Porcupine River party and its supplies aboard, left fort Yukon and three days thereafter reached camp Tittmann, the then head of navigation, distant 158 miles from the mouth of the river. The time of arrival was unavoidably ill chosen, as the July droughts had reduced the stream to its lowest summer ebb.

Observations placed camp Tittman 39 miles west of the boundary. Captain Peterson refused to tarry, since the river was still falling, as plainly indicated by wet lines along the banks and

mud flats, and the danger of being stranded on a sand-bar until the following spring was too great a possibility to be overlooked. Supplies were consequently unloaded with all the expedition possible, and the steamer returned to fort Yukon.

Had our time of arrival been delayed a week no difficulty whatever would have been experienced in landing the party at the boundary, as the river rose rapidly in a few days. A whale-boat brought from San Francisco and a large, unwieldly lighter borrowed from the Alaska Commercial company were the sole means of transportation at our command.

Lack of time forbids me to enter into a detailed account of the many difficulties and vexatious delays encountered in conveying 25 tons of supplies piecemeal 60 miles upstream in the face of a strong current, broken into rapids in many places, and around banks undermined by the action of the water and fringed with fallen trees. Many mishaps occurred despite all precautions, and serious casualties were often avoided by a mere hair's breadth. On one occasion the entire party, including several Indians, narrowly escaped drowning by being drawn into the swirling waters. Harkert, a member of the party, had the misfortune to lose the end of one finger while handling a heavy box, and Polte, another of the men, had an ankle broken while assisting the men in tracking the heavy lighter upstream.

The Indians, unfitted by disposition or previous training for such arduous work, proved unreliable. It was unfortunate, too, that early in the season an Indian, while attempting to convey a heavy tow-line across stream in his frail canoe, was capsized and drowned. The accident led to open hostility on the part of the natives, and but for the timely intervention of the Hudson Bay company's post trader, Mr Firth, the consequences might have proved serious. Several plans to murder the entire party were discussed among the hot-headed younger Indians, but the wiser counsels of older heads prevailed, and as our acquaintance with the natives progressed their mistrust and hostility gave place to friendliness.

Preliminary observations made at Rampart house demonstrated the necessity of a further march of 33 miles upstream before the boundary would be reached. A well sheltered spot was finally selected in a timbered valley at the mouth of Sunaghun river, and preparations were at once begun to build a comfortable log house for winter quarters. The work was often

interrupted by snow-storms of frequent occurrence, beginning in August. Ice began to form along the river banks in early September, and by the end of October a snowy mantle covered the country, and all the streams were fast locked in ice. The log cabin and all observatories were ready for occupation by October 1. The days rapidly shortened as the season progressed, and on November 16 the sun in his course southward disappeared beneath the horizon. During the shortest days lamps were extinguished at 11 a m and lighted at 1 p m. By 2 p m observations upon the stars were perfectly practicable. This state of affairs prevailed until January 26, on which date the sun reappeared. As the first few feeble rays of the luminary struggled through the frost-laden windows the spirits of the men brightened, and, rushing forth from the cabin, they capered about like mad men in an excess of joy.

Many Indians visited our camp during the winter months, the best season for travel. In this region of soft snow the kind of sled used on the coast is unsuitable, and is replaced by a toboggan seven feet long and two feet wide, with a large roll in front to fend off the snow. The dogs, usually four in number, are hitched tandem and so close together as to necessitates cutting off their tails. No sled dog in the Porcupine river country possesses this ornamental appendage, for it is amputated early in youth.

Among the coast tribes all the dogs possess large bushy tails, which serve the admirable purpose of keeping their noses warm in the cold winter nights. No sled trips, with the single exception of one to Rampart House late in December, were made at this time. There was no particular necessity for them, and no member of the party possessed sufficient enthusiasm to undertake a journey for the pleasure to be derived from it.

As stated before, scarcely a day passed that some Indian did not make camp Colonna his abiding place until kicked out. We found the natives inveterate beggars. There was some excuse for this, as early in January the stock of provisions at Rampart house became exhausted. The natives with characteristic improvidence had neglected in summer to lay up food for the winter, and the new year found starvation staring them in the face. Several hunting parties had gone out, to return empty-handed and to report that the deer had migrated southward. Many Indians were reduced to the necessity of subsisting upon moose-

skin bags, deer-skin thongs, and old sled covers. Several old people died of sheer starvation, and the outlook grew gloomy. Timely assistance from the missionary, Mr Wallis, and a case of flour from camp Colonna tided over the emergency until a few deer were secured by an expert hunter, who had been permitted the use of a Winchester rifle from our camp.

The main food supply of the Porcupine River Indians consists of fish and reindeer meat. In early spring this fare is supplemented by a vegetable diet of wild rhubarb and a root resembling licorice. Later in the season blueberries, raspberries and wild currants are found in abundance.

Salt is never used. Although we were supplied with an abundance of this article and offered it to the natives gratis, none seemed to desire this addition to their cooked meat. Scurvy is unknown in this portion of Alaska, and the remoteness of the settlements from the civilizing influence of the whites has prevented the introduction of several fatal diseases, but scarlet fever nearly depopulated the country many years ago. The prevailing distemper now seems to be of a pulmonary nature. Many natives seemingly in perfect health were suddenly attacked, and in a few weeks succumbed to acute pneumonia or galloping consumption. Medicine is of no avail. The doctor who accompanied the expedition administered gallons of physic, but if not present to watch the patient the course of treatment was at once discontinued unless beneficial results followed the first dose. As several Indians treated by the doctor died, his influence over them rapidly waned. From implicit confidence, the natives suddenly reverted to extreme distrust and resumed the rites for curing the sick practiced by their own "shamans." Very little attention is shown the sick. We detected the post trader's hunter in the act of devouring some crackers supplied him for his daughter, who was sick abed. The girl subsequently died, doubtless of starvation, abandoned to her fate by her unnatural father. Shortly afterward a young woman in the settlement was taken sick and permitted to slowly starve to death by a sister who subsequently attempted the destruction of her surviving child by tying it to a stake out of doors and leaving it to freeze in the winter night.

Though the Indian may evince affection for his children, it extends to no other member of the family. Father and mother, brother and sister, wife and husband are neglected as soon as

sickness overtakes them, often abandoned, and not seldom expedited into the other world by means of a club in order to save further trouble. No instance of infanticide came under my notice during our stay on Porcupine river, although very common among the coast tribes of Bering sea, and especially at Saint Michael. Cannibalism is by no means rare. A shocking instance of this was reported to us during our stay at Rampart house. Two women, running short of provisions, killed a man and a boy while asleep, and subsisted upon the remains for several weeks.

Though grasping, unscrupulous, and often dishonest in his dealings with the whites, in his own tent the Indian is a creature of another stamp. His ideas of hospitality are strangely inconsistent with his conduct in other matters. The last morsel of food is shared cheerfully with the hungry stranger, the warmest place before the fire is assigned for his use, and the snuggest corner in the tent is reserved for his sleeping hours. In the matter of cleanliness and morality the native is like unto his ancestors. No exhortation by the most eloquent missionary can force him to bathe. He fears the water like a cat. No amount of scriptural teaching can convey to his brain the first glimmering of the meaning of such a word as morality; and unless he is permitted to carry with him at all times a plentiful stock of certain insects he considers his usefulness at an end. It is somewhat singular that a race of beings so degraded and having so little need of a full language should be credited with a vocabulary of twenty thousand words. Mr Wallis, the present Church of England missionary at Rampart house, doubtless carried away by enthusiasm, assured me that in every respect the native language was far superior to the English tongue. While this statement should be taken *cum grano salis*, it is undoubtedly true that the language in question is superior to most of the native tongues in northern Alaska. Commencing at Senati's village, the language remains unchanged until Peel river is reached. It is much to be regretted that Archdeacon McDonald has provided no vocabulary or grammar to accompany his translations of the New Testament into the native tongue.

The various tribes speaking this language are divided into the Kutcha Kutchin (Senatis tribe); the Natsei Kutchin (Dwellers in the North), numbering 150 or thereabouts, residing in the country north of fort Yukon, and known also as the Gens de

Large; the Vunta Kutchin, or Lake Indians, inhabiting the region of the lakes northeast of Rampart House; the Nun Kutchin or River Indians; the Trangik Kutchin, or Black River Indians, residing on the river of the same name; and the Takudh tribes, living in the vicinity of la Pierre's house. Excepting the Takudh tribes, the other natives enumerated, numbering perhaps 500, trade at Rampart house. In former times this post was a source of great profit to the Hudson Bay company, as many black-fox skins were brought in by the Natsei Kutchin. During our ten months' residence but two skins of this kind were secured, and the yearly total of other furs has correspondingly diminished. The greatest bulk of furs is now obtained from the Black river country, and consists chiefly of black bear and beaver skins.

Eskimos from the northern coast sometimes visit Rampart house in order to exchange walrus lines for wolverine skins, which are afterwards traded to passing whalers for whisky or old-fashioned breech-loading Winchesters.

Early in March it was decided to take a journey northward along the boundary to the shores of the Arctic ocean.

A request was therefore sent to Mr Firth, at Rampart house, to provide dried meat for the trip and engage the services of two reliable natives with sleds and a runner to go ahead. This was accordingly done. Seven men and four sleds of four dogs each left camp on March 27, bound for the Arctic ocean. Two of the Indians, Edward and Moses by name, had traveled over the proposed route before, while engaged in trading with the Innuit of the northern coast, so no concern was felt on this score. The temperature had risen gradually during the previous day, and bright skies and sleeping winds indicated that the time was ripe for making the start. In addition to the dried meat, pemmican and a supply of canned meats, with a modicum of alcohol stowed away in the event of snake bite, completed the stock of provisions. My sled was loaded with a camera outfit and various instruments for the determination of geographical positions, heights, etc.

It was noon when the final preparations were completed and the party started. Bergman, Foreman and Engelstad accompanied the party. On the first day six miles were made, and the party camped for the night in a grove of spruce, with dry standing wood conveniently near. The mode of camping

as practiced by the Indians and hunters along the river is as follows: A well-sheltered spot is selected in a clump of spruce, with abundance of dry wood in the immediate vicinity. After unhitching the dogs, which is the first proceeding, the snow-shoes are removed and used as shovels to clear away a space twenty feet square and from two and a half to five feet in depth. An abundance of green boughs are then scattered evenly over the floor, the sides braced by brush, and a back rest is secured by laying several sticks lengthwise to a height sufficient to serve as a wind break. A quantity of dry timber is then heaped up on the opposite side and fired. Skins are spread over the spruce brush on the floor, parkas, blankets, harness, etc, are hung over the sides, and the camp is finished. The dogs are fed first, after the meat carried for the purpose has been thawed out before the fire. During this interval the men, in our case at least, stay the pangs of hunger by pieces of pemmican, succulent as chips, followed by the inevitable pipe. A pot full of dried meat is then boiled and a large kettle of strong tea brewed; pilot bread or flapjacks, if procurable, complete the bill of fare. We had provisions for twelve days, but expected to be away for eighteen, so it behooved us to watch the larder with a jealous eye.

Early in the morning, next day, the party followed the windings of Sunaghun river, and ascended the long slope leading to Boundary rock, so named from its proximity to the international boundary. It was decided to ascend the rock, which projects about 100 feet above the general surface. From this elevated point, 2,700 feet above the sea and 1,900 feet above camp Colonna, an excellent view was obtained of the surrounding country. To the eastward the windings of the Porcupine could be traced for miles; to the westward a short but bold range of mountains, seemingly volcanic, cut off the view. A bank of fog overhung the river, and masses of vapor filled the valleys in various directions. There was scarcely enough wind blowing to lift a feather, and all looked forward in happy anticipation to a swift and easy journey. It was determined to camp for the night in a small valley some few miles to the northward, and all haste was made to rejoin the sleds, which were on the full gallop and liable to outdistance us. A few minutes after overtaking the sleds a sudden roaring assailed our ears, a fog-bank to the eastward burst asunder, and from its recesses issued forth a wind that nearly swept us from our feet. Clouds of glit-

tering snow filled the air and beat upon us with all the fury of a hail-storm. It was only by the most strenuous exertions that we were enabled to reach the sleds, which had taken shelter under the lee of a small hill. In that brief time the end of my nose, one temple and the tip of the right ear were frozen solid, and a broad white streak fully an inch wide, extending from eye to chin, bore evidence of the rapidity with which a man may freeze if the conditions be favorable. All expedition possible was necessary to gain the shelter of the friendly trees. For the remainder of that day, that night, and until noon of the following day the shrieking north wind swept over the trackless wastes in all the fury of a Dakota blizzard. Traveling was quite out of the question; men and dogs huddled together in a promiscuous heap, striving to secure protection from the biting blast.

The next morning everything had changed; the sun shone out bright again, and the wind had died away. During the forenoon we climbed continually up the further side of the valley, and about 12 o'clock reached the summit of a pass at an altitude of 2,500 feet. Spread out before us and extending eastward to the furthest horizon, appeared a plain covered with a dense growth of spruce, birch and cottonwood—a veritable oasis in the midst of utter desolation. Its western limit was a plateau, doubtless the northern continuation of the eastern front of the Porcupine ramparts. Fifty miles away to the northward a range of low mountains was discerned, trending to the eastward, and forming the northern boundary of the plain. As I afterward discovered, they form the true water-shed of northeastern Alaska and the country beyond to Mackenzie river.

It took three days to cross this plain. On the first day a tribe of Nigalek Eskimos were encountered. They were fine-looking savages and seemed much surprised to meet white men so far away from the trading posts. They broke camp on the following day and started northward for the summer hunt on the Arctic.

We crossed innumerable lakes during the next few days, and on the fifth day crossed the mountains at an altitude of 3,000 feet. The descent on the northern slope was abrupt. My burly foreman covered the distance rapidly by sliding down head foremost, necessitating various repairs to certain portions of his trousers. We found the temperature much lower on the north-

ern side of the mountains, ranging from — 20° to — 50° Fahr. I slept in a parka and beneath a deerskin robe. In the morning the long hair around the front of the hood was one mass of ice, which had to be thawed out before the parka became manageable.

After descending the mountains, the route led through a valley hemmed in by most forbidding-looking mountains, running up in jagged spurs to a height of 6,000 or 8,000 feet. Three rivers in this valley run into one, which has its outlet near the eastern extremity of the basin. A large area was covered with ice, the result of overflow, but at the outlet the current had worn its way through the ice, and the vapor arising from the exposed surface gave the appearance, at a distance, of a boiling spring. This river was followed to the shores of the Arctic ocean, passing often between towering mountains or through gloomy canyons, where the wind howled dismally.

On the eighteenth day, April 8, the ocean was reached. A stiff breeze was blowing from the southeast and the mercury registered — 30°. A fire of driftwood was made and shelter was secured under the lee of a snow bank. The drifting snow shrouded the horizon until late in the afternoon, when the wind ceased and a long line of hummocky ice was revealed skirting the gloomy shore.

A record of our visit was inclosed in a brass shell, some observations were made, and early the next day the return trip was begun. Camp Colonna was reached in six days, a rapid journey considering the nature of the country, the frigid temperature and the depth of the snow.

Although the season was already well advanced and the sun well on his northern journey, not the slightest evidence of a thaw could be detected north of the valley of the Three Rivers. The stream, which was followed to the ocean, was frozen to the bottom, objects ten feet beneath the ice being plainly visible through the transparent medium.

COLLINSON'S ARCTIC JOURNEY

BY

GENERAL A. W. GREELY

(*Presented by title before the Society April 3, 1892*)

Somewhat more than a year ago the members and guests of the National Geographic Society had the great pleasure of hearing from the lips of Lieutenant-Commander Charles H. Stockton, U S N, a detailed and interesting account of his remarkable voyage in the U S S *Thetis*, during the summer and autumn of 1889, from San Francisco through Bering strait, around point Barrow, eastward to the mouth of Mackenzie river, and thence westward to Herald and Wrangell islands, whence he returned to his home port. It was a remarkable voyage, and Commander Stockton deserves especial credit for the professional ability and personal energy displayed by him throughout so trying and so successful a trip.

This account, somewhat enlarged, has been written up by another hand than Stockton's and published for a very large audience, the readers of *Scribner's Magazine*, April, 1891. The value of all journeys to remote regions depends primarily on the fidelity and accuracy with which the account of such voyages may be written. No one who knows Commander Stockton, or who has heard his personal account, doubts that he has rather understated than exaggerated the circumstances of his voyage. It is therefore with a feeling of very great disappointment that every well informed reader must have perused the opening paragraphs, which are incorrect in statement and most unjust by inference to the gallant predecessors of Commander Stockton.

The article, entitled "Where the Ice never Melts," begins as follows:

"Two score years ago—it was in August, 1850—a vessel lay at anchor far to the north, beyond the Arctic circle. To the south of her rose a lofty cone-shaped island; to the north, to the east, to the west, beyond the narrow lane of open water wherein she lay, stretched for untold miles the blue ice, that, hard as granite, yields nothing to the blaze of the sun-

Above her was the gray Arctic sky, colder even to behold than the blue ice itself. All around was the silence of the far north—the terrible Arctic silence that drives men mad with the longing for some sound. Only the coming and going of the vessel's crew gave life to the scene.

"The vessel was Her Britannic Majesty's ship *Investigator*, Captain McClure; the place was the mouth of the great river Mackenzie; the island was that named in honor of the famous astronomer, Sir William Herschel.

"For nearly two score years no vessel crossed the waters of Mackenzie bay. Herschel island, unvisited for more than a generation, was but a name on the maps. At last one summer drove back the ice farther than before in forty years, and the west wind helped it, and then through the narrow lanes of water and through the shifting ice came nine vessels, eight of them dingy craft—whaling vessels—but the other a trim ship, whose sails were white, whose metal-work shone, from whose peak fluttered the stars and stripes—the United States steamer *Thetis*, commanded by Lieutenant-Commander Stockton, the first man-of-war that ever reached Herschel island, the first vessel ever to fly in that lonely place the flag of the United States."

The Arctic voyage made by the late Captain (afterwards Admiral) Sir Richard Collinson in H M S *Enterprise*, from 1851 to 1854, was perhaps, everything considered, the most successful expedition made in Arctic research prior to the use of steam. Collinson passed point Barrow in 1851 and wintered for that season in Walker bay (71° 35′ N., 170° 39′ W.), on Prince Albert land, to the east of Bank's or Baring's land. The next season, 1852–3, he wintered in Cambridge bay (69° 3′ N., 105° 12′ W.). He left Cambridge bay in the summer of 1853, on August 10, and on September 15 reached Camden bay, near Flaxman island, between the Mackenzie and point Barrow. The sea was nearly open, but strong easterly winds, packing the ice to the west of the bay, formed a sufficient barrier to prevent Collinson escaping from the ice, especially as he was depending entirely on sail. The *Enterprise* here wintered in 70° 8′ N., 145° 29′ W., and in the ensuing summer, on July 20, 1854, was able to sail eastward to Bering strait.

As already said, Collinson's voyage was remarkably successful. Herschel island, which was reached by Stockton and the American whalers *under steam*, is about 15° in longitude east of point Barrow; but Collinson took his vessel *under sail* about 40° east of that point, or nearly three times as far beyond point Barrow.

Parry, in his wonderful voyage to Winter harbor, traversed only 30° of longitude from the open water of Lancaster sound, but Collinson took his vessel nearly twice as far from the free waters of Bering strait. It should be noted to Collinson's credit that the series of straits through which he tacked his vessel were the worst that have ever been successfully navigated to a considerable distance by any Arctic expedition, and that in addition to his journey from Bering strait to Cambridge bay and return he also carried the *Enterprise* up McClure strait to as high a point as was reached by the *Investigator*. In short, no other vessel came so near completing the Northwest Passage as the *Enterprise*.

The writer of the article referred to was not ignorant of Collinson's journey, for on page 480 he refers to the fact that Collinson wintered at Camden bay in 1853–4.

On the other hand, McClure never visited Herschel island. It is not mentioned in any of his reports, and the track charts, both in Armstrong's "Northwest Passage" and in Osborn's account of McClure's voyage, show that the *Investigator*, under McClure, left the American coast near Camden bay and steered northeastward into the polar pack, into which the *Investigator* penetrated nearly ninety miles from land. Obliged by the closing ice to turn backward, McClure made Pelly island, on the eastern side of Mackenzie river, thus making a long detour in which his nearest approach to Herschel island was at a point about twenty-five miles northeast of it.

The records thus show that McClure found an open sea from point Barrow eastward in 1850, Collinson in 1851 and 1853, and Stockton in 1889, while the American whalers came safely back in 1890. In short, it may be said that nearly every year the Mackenzie may be reached by steam whalers, and that the ice is neither eternal nor fixed along the shores of northern Alaska and the Mackenzie River region.

It appears to be a proper labor for the National Geographic Society to favor the correction of errors relating to noted journeys and ill known regions; hence this attempt to do justice to Collinson and to correct the inferential error as to the Mackenzie river which by a flight of fancy only, can be described as a land "Where the ice never melts."

NOTES.

Topographic Survey of Canada.—Some two years ago a book on the subject of photographic surveying by Mr E. Deville, surveyor general of Canada, was issued by the Dominion land office. Apparently this is a book of instructions, and treats exhaustively of the methods of photographing and of using photographs for constructing maps therefrom.

Since few are acquainted with this subject, it may be well to characterize briefly the method of surveying by photography. A few points, including all occupied stations, are located by angular measurements. From the occupied points, photographs of the surrounding topography are taken, a complete round of the horizon usually being made from each station. Devices are employed for facilitating the measurement of horizontal and vertical angles from the photographs, and the photographs are sent to the central office at Ottawa, where maps are constructed from them. Angles are measured from the photographs, and thus all points for location are fixed, their heights determined and contour lines located.

To topographers on the southern side of the boundary this appears to be a very indirect way of making a map. Most of those who have studied the subject are aware that this method has been experimented with by several countries and discarded by all except Italy and Canada. The topographers of all other countries are accustomed to making maps directly in the field, using the country itself as copy, and not passing it through the medium of a photograph. By this simple and direct method it is believed that a more lifelike transcript of the original can be obtained, and, moreover, that the work can thus be done more rapidly and at less expense.

A few sheets recently issued by the Dominion land office appear to sustain this position. They are lithographed on a scale of 1 : 40,000, relief being expressed by contours at intervals of 100 feet and by shading. They represent a portion of the Rocky mountain region on the line of the Canadian Pacific railway. In many respects these maps are very creditable productions. A commendable attempt has been made to map a wild and unknown region, and the use of hill shading, combined with con-

tours, is a move toward giving a graphic presentation of the appearance of the country. The shading is not altogether satisfactory, owing, perhaps, to lack of practice on the part of the draughtsman, as this is something which requires years of study to produce with good effect. The maps are printed in five colors, though probably one of these, red (used to represent trails and roads) might well have been replaced by black. The brown for the contours, green to represent forests, and blue for drainage, with black for culture, gives one of the most satisfactory and effective combinations possible.

There are, however, some serious defects in these maps. The representation of the topographic features is hardly natural. There is a want of detail and little suggestion of the ruggedness of the country. An experienced topographer immediately notes many features which are plainly due to misinterpretation of the photographs. From the appearance of the country as mapped one would expect to be able to take a pack-train anywhere, whereas in reality the ruggedness of the country forbids travel even on foot in the greater portion of this region. These are results of the extreme generalization due to the making of maps from photographs. The scale employed might well be reduced, say, to 2 miles to an inch. This scale would be amply large to show every detail represented, and would be more in consonance with the vertical scale of 100-foot contour intervals which is employed.

Apparently but a small number of stations were occupied in mapping the country. On one of these sheets in particular, the Anthracite sheet, but one station appears to have been occupied in a total area of 65 square miles. The expense of this work, eight dollars per square mile, is double that of work on a scale of 2 miles to the inch on this side of the boundary, with which it may be compared.

H. M. W.

Lieutenant Peary's Crossing of Northern Greenland.—The following account of this remarkable journey is condensed from the only official sources available, which are the accounts over Lieutenant Peary's signature in the New York *Sun* of October 25 and 31, 1892. Lieutenant Peary's party of seven wintered at Red cliff, on the shore of McCormick bay, in about 77° 7′ N. 71° W. On April 30, 1892, the advance travelling party left Red cliff, followed May 2 by Lieutenant Peary. Besides the

leader, the expedition consisted of Dr Cook, Gibson, Astrup, Matt and seven Eskimo, with three sledges and 20 dogs. Within a few miles the summit of the inland ice was reached at a spot 2,500 feet above sea level, where a cache camp was established near a "nunatak" (the Eskimo name for a rocky peak rising above the level of the surrounding inland ice). From this point Matt was sent back, owing to a frozen heel. A second "igloo" (snow-house) was built on May 8, but afterward snow-houses were dispensed with as demanding too much time to construct.

By May 14, after extremely fatiguing work and double banking, the true inland ice may be said to have been reached. By this time 16 out of 20 dogs remained and the disabled sledges were reduced from eight to four, all of one type. The party were individually equipped with a deerskin "kooletah" and sleeping bag, a sealskin "timiak," and seal "kamiks" or moccasins. The party crossed the divide of the inland ice between Whale sound and Kane basin at an elevation of 5,000 feet, and thence descended toward the basin of Humboldt glacier. The course of travel was toward the northeast, and camp Separation was made 130 miles from McCormick bay. At this point it was decided that Lieutenant Peary should go forward with Astrup, while Dr Cook and Gibson, with a light sledge and two dogs, and rations for twelve days, should return to McCormick bay.

On May 31 Lieutenant Peary reached the divide of inland ice and looked down on the basin of Petermann fiord. He was obliged, owing to crevasses, to deflect ten miles to the eastward, where he made camp Petermann, at which he remained 36 hours to determine his position and take bearings. From this point gigantic crevasses obliged him to travel due eastward for ten miles, when he took a course northeastward, hoping to clear the basin of Sherard Osborne fiord.

Crossing another divide of the inland ice, June 8 found Lieutenant Peary and his party descending into Saint George fiord, which penetrates far inland. Here they were detained two days by a severe storm, after which the character of the glacier ice to the northward was so unfavorable that they were obliged to turn southward and eastward, and after two days of hard work found that they had lost 15 miles of their northing, besides injuring their team. The point reached on the inland ice was now 6,000 feet above the level of the sea. A northeasterly course was again

followed, but unfavorable ice and enormous crevasses obliged frequent detours eastward.

On June 26, still at an elevation of 6,000 feet, the course was northeastward, but land appearing in that course, a detour eastward was again necessary, which led to a comparatively flat, round-topped, ice-clad land. Skirting the edge of the inland ice parallel with the land, they reached their highest northing on the 82d parallel. Here there was land to the northwest, northward and northeast. Of its character Lieutenant Peary says: "Dark-brown and red cliffs looked down into a grand, vertical-walled canyon reaching up toward our camp; and everywhere, to the northwest, north and east, black and dark-red precipices, deep valleys, mountains capped with cloud-shadowed domes of ice, stretched away in a wild panorama." From this point Lieutenant Peary was obliged to travel toward the southeast parallel with the edge of the inland ice and the shore land.

On July 1 a wide opening between high vertical cliffs allowed Lieutenant Peary to travel northeastward and quit the summit of the inland ice, then 5,000 feet above sea level. Following down a steep gradient toward the red-brown land, rivers and lakes became visible along the margin of the ice, and the party finally reached the highest point of a moraine after wading many streams and floundering through much melting snow. Leaving Astrup and his team at this point, Lieutenant Peary started northeastward to climb a cliff which apparently commanded a view of the coast and seemed to be only five miles away. The mountain appeared to recede as he advanced, and after eight hours' work to reach the summit, it proved that intervening hills shut out a full view of the coast. By this time Lieutenant Peary's foot-gear was practically worn out and his feet injured from the broken sharp rocks, and it was only by improvising foot-gear from his sealskin mittens and cap that he was able to return to camp. On July 3 with Astrup he descended to the shore and kept along the crest of rock-strewn mountains.

Finally, on July 4, they reached the summit of a rocky plateau with a sheer face rising 4,000 feet above the bay, which was named Independence bay from the day of its discovery. On the east was a great ice stream named Academy glacier, beyond which rose a yet higher vertical cliff, on a portion of which rested a great projecting tongue of inland ice.

Of the view Lieutenant Peary says: "Some 15 miles northeast from where we stood these cliffs ended in a bold cape, just beyond the fan-shaped face of the great glacier, and the shore from there swept away to the eastward. West of us lay the opening of the fiord which had barred our northern advance. Northwest stretched steep, red-brown bluffs with a flat foreshore reaching to the water's edge. The resemblance of these bluffs to the eastern shore of McCormick bay was very striking. Close at hand a single isolated ice cap crested these bluffs, but disappeared in the middle distance, and beyond that the shores which stretched far away to the northeast were free of snow and the summits free of ice caps.

"The bay itself beyond the glacier face seemed perfectly smooth, and far out in its center a clouded appearance showed the beginning of the process of disintegration in the formation of water pools upon the surface. Between the bold cape on the right and the distant northern shore the white level of the sea ice stretched out to meet the distant horizon over the mysterious eastern Arctic ocean."

Observations for position were made, those for longitude being based on equal altitudes, with the resulting latitude of 81° 37′ 4″ N, and a longitude (from map) of about 34° W. A cairn was raised, in which were placed a record of the journey, a thermometer, and copies of the New York *Sun* and *Harper's Weekly*. The national flags belonging to the Philadelphia Academy of Natural Sciences and the National Geographic Society (the latter flag presented by Miss Dahlgren) were displayed. The arctic poppy and other flowers, purple and white, were present, together with the snowbunting. Musk-ox trails were frequent, and five musk-oxen were killed. The return to McCormick bay was made in nearly a straight line, and the main divide of the inland ice was crossed at an elevation of 8,000 feet. The main incidents of the return journey were an experience of the most violent storm and the loss of several dogs, whereby the number was reduced to five. The return journey occupied thirty-one days.

The journey of Lieutenant Peary is most extraordinary. Its most important geographic result is the determination of a great fiord opening eastward into the Greenland sea at a point some 200 miles north of the highest position reached on the *eastern* coast of Greenland by any of Lieutenant Peary's predecessors.

Perhaps not less important is the confirmation of the opinion expressed eight years ago by General Greely that Greenland ends near the 82d parallel, and that the land to the northward is probably separate. Lieutenant Peary's most northerly point, in latitude 82°, was that looking down on the great fiord which debouches in Independence bay. It is of course not proved, but it is almost beyond question, that this is a continuation of Nordenskiold inlet, which begins in the Polar ocean near the 83d parallel. Of this fiord, discovered by Lieutenant Lockwood May 6, 1882, that lamented and distinguished officer says: "The fiord at whose mouth we camped ran to the southeast or south to an immense distance; no land visible at its head." Lockwood was a very conservative man, and he charted this fiord southeastward to only longitude 45, which is but five degrees eastward, or less than fifty miles northwest of the most northerly point reached by Lieutenant Peary. The character of the land seen by Peary to the north and northwest indicates satisfactorily that these two fiords are one, as charted by Lieutenant Peary in the New York *Sun* of October 31. The discovery of musk-oxen at Independence bay confirms General Greely's supposition, put forth in 1884, that these animals reach the eastern coast of Greenland through Nordenskiold or some adjacent inlet.

In his sketch map (New York *Sun*, October 31) Peary extends the northern coast of Independence bay some fifty miles eastward, to about 25° west longitude. This easterly extension of bold, high, ice-free land, with intervening water, whereon the ice was in the process of disintegration, makes it exceedingly doubtful if a very high northing can be made on that coast, with McCormick bay as a base. With Thank-God harbor as a home station, however, there will be no serious difficulty in making a very high latitude, say 85° N., either via Lockwood's route or across the inland ice to Independence bay.

A. W. G.

Geographic Prizes.—The National Geographic Society, with a view of encouraging geography in the public high schools of the United States, has instituted certificates and medals which are to be awarded annually in each state to such graduating pupils of public high schools as shall write the best original geographic essays on subjects to be selected by a committee of the Society. It is intended that each essay shall pertain to the continent of

North America, and that it shall be comprehensive in its scope and limited in its length, so as to afford opportunity for originality of treatment. The coöperation of state superintendents of education will be sought by the Society. The best essayist of each state will receive a certificate of efficiency from the National Geographic Society. The Geographic Gold Medal of the National Geographic Society will be awarded to the best essayist of the entire country, while the second best essayist will receive a certificate of honorable mention. The subject of the essay for 1893 will be announced shortly.

GENERAL RULES.

1. Essays will be received only from such public high schools as formally announce their intention to compete by May 31 of each year.

2. All essays must be entirely composed by the pupil, who must certify on honor that he has not received aid from any person.

3. No essay shall exceed 2,500 words in length.

4. In each state the superintendent of public schools, if his coöperation can be secured, will select by such process as he deems advisable the three best essays, which shall be passed on by a committee of the National Geographic Society in order to select the best essay for each state and for the United States.

5. The certificate issued to the best essayist of each state shall set forth in proper terms that ....., being one of ..... essayists from ..... public high school, in the state of ....., is awarded this certificate by THE NATIONAL GEOGRAPHIC SOCIETY for his proficiency in geographic science.

6. No certificate shall be awarded to any competitor unless in the opinion of the judges the essay offered possesses sufficient merit to justify such award.

It is desired that the superintendent of public schools in each state shall select, by such method as he deems advisable, the three best essays, and from the collection of such essays the committee of the National Geographic Society will select the best essay for each state and for the United States. One of the most important aims of the National Geographic Society is to stimulate and make more practical the study of geography, particularly with reference to America. The Society therefore seeks the coöperation of all educational workers in making its labors more efficient and general. To this end gifts for medals and scholarships are solicited and identification with the Society by active membership and personal effort are urged.

The Society already comprises among its active workers a considerable number of geographic scientists, who have given liberally of their time and efforts with a view of stimulating public interest in geographic education. The Society is a working one, and in its efforts to exercise an educational influence over the whole of the United States feels justified in asking liberal support from high-spirited citizens. The Society numbers among its members over 700 persons and has active representatives in every state and territory.

General A. W. Greely, United States Army; Professor T. C. Mendenhall, superintendent of the United States Coast and Geodetic Survey, and Professor W. B. Powell, superintendent of public schools of the District of Columbia, constitute the committee charged with the selection of the subject and award of the prizes for 1893.